

THE 1960 SMITHSONIAN-BREDIN MAYALAND EXPEDITION

Following the 1959 Caribbean expedition, the Mayaland expedition, was organized primarily for the purpose of sampling the marine fauna and the insect life of the east coast of the Mexican Territory of Quintana Roo, Yucatan, and of the nearby islands of Mujeres and Cozumel. This expedition remained in the field from March 26 through May 6, 1960.

From this seldom visited and very considerable stretch of coast the United States National Museum has received over the years little in the way of specimens, marine or terrestrial. Hence our keen interest to have a go at it on this sixth of the expeditions that Mr. and Mrs. J. Bruce Bredin of Wilmington, Delaware, have sponsored for the Smithsonian Institution. It was their fourth to the Caribbean.

Although the former U. S. Fish Commission Str. Albatross in January-February 1885 accomplished some dredging and dragging of tangles on the ocean bottom off the northern end of the Yucatan peninsula, and off the south end of the island of Cozumel at depths exceeding 100 fathoms, and brought back a few shallow-water animals which now repose in the National Museum; and though the Carnegie Institution of Washington (Publication No. 491, 1938), rather completely reported upon the animal and plant life collected in 1936 chiefly in the caves and cenotes of Yucatan, the marine littoral hitherto had received but scant attention.

All that the Museum possessed in the way of seashore life from the waters along the east coast of Yucatan were several small lots of marine invertebrates picked up by friends of the Institution prior to 1940.

Best remembered is Ralph Elliott of the United States Department of Agriculture and presently agricultural attache with our Embassy in Guatemala. In the course of his 1938 cruise in his 45-foot ketch Trail Star, he obtained several decapod crustaceans from the very area which we visited this year. It is to be expected that the specimen from the seldom collected east coast of Yucatan will yield a number of new records of occurrence, as well as extensions of geographic range.

Five zoologists comprised the scientific staff: Dr. Waldo L. Schmitt, Research Associate, Smithsonian Institution, marine biologist especially interested in shrimps and crabs, and their close relatives; Dr. J. F. Gates Clarke, Curator of Insects, U. S. National Museum, an authority on economically important tiny moths (Microlepidoptera - "micros" for short); Dr. Harold A. Rehder, Curator of Mollusks, U. S. National Museum, who plans a report on the marine shells of the Quintana Roo littoral; Dr. Franklin C. Daiber, Professor of Zoology, Department of Biological Sciences, University of Delaware, ichthyologist and estuarine ecologist, whose chief concern on this occasion was an ecologic study of a mangrove swamp and its associated fish population; and Dr. Edward L. Bousfield, Curator of Invertebrate Zoology, National Museum of Canada, Ottawa, a carcinologist specializing on barnacles and amphipod crustaceans, especially the beach-inhabiting and terrestrial forms. Mr. Bredin and his brother-in-law, Mr. Ernest N. May, also of Wilmington, took part in the activities of the expedition during the last week of April, visiting the Maya ruins of Chichen Itza and Uxmal near Merida, and the island of

Cozumel with three members of the field party, Daiber, Rehder, and Schmitt. The others, Bousfield and Clarke, had to return home on April 24 because of other commitments.

Five weeks and a day marked the actual span of this Yucatan expedition from the time we quit the restless, open roadstead of Progreso on March 26 until we left Mexican waters on April 30 for Georgetown, Cayman Islands. There, after a 74-hour passage, we parted company with our chartered 70-foot auxiliary schooner on May 6, to return to Washington.

In Progreso the purchase of supplies beyond those obtained in Miami, and an additional and heavier anchor that the winds here warned us might be needed, left only very limited time for collecting. This was chiefly accomplished by Drs. Clarke and Daiber in and about the nearby lagoon and mangrove swamp. Some shells were picked up by Dr. Rehder, who scoured the beaches. At Isla Mujeres, our next port of call, four scientifically profitable days were spent, March 28 through 31. The reefs, shoals, turtle grass flats, and stands of mangroves were very reminiscent of the Florida Key area in faunal aspect. Corals, gorgonians, sponges, mollusks, crustaceans, fish, and algae were gathered in fair quantity within the spacious harbor and along the outer reaches of the island. We left for San Miguel, island of Cozumel, shortly after sun-up April 1 and dropped anchor off the pier there the very same evening at half-past six.

It was off San Miguel that we had our first adventure, and one quite unanticipated. We were bent on fishing for deepwater mollusks with the unique rattan traps that John Finlay had devised, and to which he introduced us on the 1958 Smithsonian-Bredin Caribbean Expedition. Dr. Rehder and I wanted to "fish" the Cozumel channel where the 100-fathom curve was but a half-mile off shore. True, the current here runs swiftly, all of $2\frac{1}{2}$ knots, but with plenty of line, as John advised, and what we deemed sufficient weight, two traps were put over late one afternoon within sight of one another to facilitate locating them before sun-up the next morning. As planned, we turned out early the next morning. In the half light, the channel and its unquiet sea were none too inviting, and the current appeared ever so much more swift than the evening before. But the large, well-inflated automobile tires that buoyed our lines were not where they should have been, had all gone well. We started then to cruise in circles working more and more to the northward of our bearings on the San Miguel light and pier, in the direction of the current flow. We persevered to no purpose, for having undoubtedly miscalculated the strength of the current, we had lost our gear.

Adventures can't be planned, except perhaps in movie scripts. Our present one was suddenly thrust upon us with the utter failure of the outboard motor which powered our dinghy. It refused to start no matter how hard our crewman, Hal, worked on it. Just when one needs it most the typical charter-boat outboard seems to let one down. Here we were out in this 2-3 knot current being borne swiftly away from "home" and breakfast. Though we did spell one another at the oars, we

were drifting north more rapidly than we were making headway toward shore. Already we had visions of missing the north end of Cozumel, and of a future of some uncertainty. Some 4 or 5 miles above San Miguel, Ing. Raul Gonzalez Rivero was building his "Cabanas del Caribe," an attractive resort hotel, motel style, with cottages, dining hall, bar, swimming pool, and playa, Santa Pilar Beach. The sun was well up by this time and the resort's boatman was at work on shore. Quite providentially he looked out to sea and noted our predicament, helplessness is a better word, and in less time than it takes to tell he had jumped into Gonzalez' runabout and before long was tossing us a towline. It was well toward 9 o'clock before we got "home" again. The "affair" could have turned out less happily had the young man in question been less observant, or less keen of sight.

To better express our appreciation of the rescue, we not only filled up the runabout's gas tanks, and rewarded her "captain," but we journeyed up to the Cabanas this very same midday to thank the proprietor, and to enjoy dinner at his establishment. By so doing we became acquainted with Mrs. Emmett Gowan. Her husband, the resort's fishing guide, is an exceptionally well-posted man on local conditions, people, and game fishing. As he was away this day, we invited the Gowans to have lunch aboard our schooner at their early convenience. Two days later, Mrs. Gowan being unable to come, Emmett brought along a good friend, Tony Halik, free-lance photographer, who roams the world around for "Life." Long will be remembered the day, April 4, 1960, that they came aboard for lunch.

Our amidship cabin was a snug fit for the seven of us, but all the more intimate for rubbing elbows, telling fish tales, talk of navigational hazards, and of the Boca de Paila camp over which Emmett presided on the mainland. Quite happily we had come to dessert and coffee, but just as the canned peaches were being passed, the gentle rhythm of the ship's riding at anchor was suddenly broken. From out of nowhere, it seemed, utterly without warning, a fiercely bitter gale driving shoreward bore down on us, one of those violent gusty westerlies with 40-mile-an-hour or better winds, a blow such as the native people hreabouts call a "bonanza."

Desert and coffee were forgotten in the urgency and commotion of the moment. The heaving and straining of Gowan's plexiglass twin-outboard threatened any moment to snap its painter. There was not a second to lose. Without as much as by-your-leave, Gowan and Halik tumbled aboard their light motorboat, cast off, and scudded down the coast for Caleta Bay, the only natural small boat shelter on the island, 4 miles to the south, shallow but safe and landlocked.

Aboard the schooner, we too had to be on the jump. There was the engine to start, and a dragging anchor, and two dinghies to get aboard. The violent on-shore gusts of wind threatened us with the same dire fate that a similar squall, just a few months before, had meted out to an older and larger schooner now piled up with broken back on the shoals between our insecure anchorage and the shore. In calmer weather that grim reminder serves as the aquatic playground of the local youngsters. They love to swing out, and up on a line hanging from the masthead, to plummet down into the sea.

"It is an ill wind that blows nobody good." This rather violent squall got us under way for Espiritu Santo and Ascension Bays with more expedition than we had previously thought possible. From an inspection of the Hydrographic Office charts we had picked these bays as promising collecting grounds to which we wished to devote the next 2 weeks. As it turned out on this occasion, we could only briefly reconnoiter them. On arrival at the first named, the captain came to us with a "problem" he called it--virtually empty fuel tanks! There was nothing left but to hasten back. However, we did see enough of both bays to agree with Dr. Daiber that Ascension Bay was the better place to pursue his ecologic study of a mangrove swamp.

So good did the weather prove to be on this unscheduled return to Cozumel that we tried to make the most of it. After refuelling on April 8, we ran up to have a look at the extensive bank off the north end of the island, an exposed, indifferently charted area that the captain had been fearful of tackling before.

Finding a favorable anchorage in those coral "infested" waters calls for an alert lookout but too late did ours, perched up on the foremast, call down that we were hard upon a huge coral head too near the surface for a vessel drawing 9 feet to clear. Despite the helmsman's most strenuous efforts the port bow slammed into that immovable mass of coral rock. The mighty thump, the ominous grinding, and the shudder that ran through the ship not only brought us up short, but made us fear the worst. There was a rush forward on deck, and below to check the damage, but only with an aqualung was it possible to determine that the nasty

gash 3 feet below the waterline was only skin deep and that our cruise had not been brought to an untimely end.

Working along the shore of the large lagoon at the north end of the island, Dr. Clarke hit upon a unique and an exceedingly productive method of gathering in the small beach-life commonly found in and under the wrack left by wave and tide on many shores--throw some of this stranded flotsam in the water close by. Everything alive in it apparently aware that it would soon become part of some hungry fish's meal, makes all haste to get out of the "drink." Should the wet trouser leg of the collector who started all this be closer at hand than the beach, it becomes crowded with little arthropods frantically seeking refuge--insects, myriapods, and beach-fleas. Thus it becomes an easy matter to pick them off with forceps or scrape them up with the lip of a bottle or vial. It's a superlative method. Another way of capturing these ubiquitous creatures is to buy a not too shallow pan, 2 to 3 inches deep, with about an inch of 5 percent formaldehyde solution in the bottom, so that its edge is level with the surface of the sand. Leave it out overnight and the next morning you will be rewarded with a rich haul of specimens.

April 10 saw us back in Ascensión Bay. Quite shallow for the most part like Espiritu Santo, it is somewhat larger, perhaps 8 miles across the entrance and varying from 5 to 11 miles wide inside. It extends back into the land some 16 miles. This great bay has about everything a marine biologist could want in the way of good collecting

grounds: a barrier or fringing reef, coral studded flats and muddy shoals, turtle grass in abundance, rocky shores, tide pools, lovely beaches, lagoons, extensive mangrove swamps, deep water not too far outside the reef, and for tropical insect life, a variety of habitats in the xerophytic "bush" on shore.

The first biological surprise was the swarming of the little dark brownish-looking, blue-speckled jellyfish that were hastening by the ship the morning of April 14. Literally thousands of half-inch high and slightly wider "thimbles" seemed to be spinning clockwise rushing along in several streaks, or bands. Though none of us had ever seen anything like it, this species of tentacle-less jellyfish with scalloped margin, Linuche unguiculata, in the spring in the Bahama-Florida region is said to form swarms miles in extent. When they mature in April, they rise to the surface in immense numbers. The ripe female gonads are slate colored, a blue-gray perhaps, the male, yellowish brown. The eggs are discharged and fertilized in the sea about 8 p.m. after which the jellyfish sink to the bottom to die. The species goes through an alternation of generations. The egg develops into a little sessile dantlike organism from which the larval jellyfish are pinched off, or shed by a process known as strobilization, to become free-swimming and to grow up to mature next April, to repeat the cycle. I do not know if Linuche swarms every year, but this Ascension Bay swarm is the first I've ever witnessed though I have cruised the Caribbean several Aprils in succession. Reported most widely distributed in tropic seas, the Museum heretofore only had specimens from off the coast of Cuba, the Bahamas, and Florida, drifting in the Gulf Stream. It so happens that

Dr. Clarke did find a number of this same species tumbling about in the surf when he went ashore collecting micros the evening of April 11. Therefore, they surely were about on the intervening days, but as we were severally and otherwise busy, the swarming between the 12th and 14th must have escaped our notice. The swarming petered out on the 15th of the month.

As surprising as the Linuche swarm on the 14th was the presence in the same day, as far as we could make out, of three and three only, specimens of a delicately pastel-tinted purple, 8-tentacled jellyfish with a "bell" about $1\frac{1}{2}$ inches high and nearly 2 inches in diameter--Pelagia cyanella. This is likewise a tropic-sea form, known from around the world, and also said to swarm at times in considerable numbers. In this species the development is direct. The fertilized egg develops into a free-swimming larval form, the planula, which grows to become a mature Pelagia in turn.

Still another Ascension Bay surprise was turned up by our indefatigable Dr. Clarke. With his setup for collecting flying insects at night--an expanse of white sheeting illuminated by two strong Coleman lights--he captured a single specimen of a micro found previously only in the southern States where it is not uncommon and where its larvae feed on palmettoes. The larval habit is undoubtedly the same here for palmettoes are common in Yucatán. In the American tropics this bizarre-looking moth (Fig.) may be just about as widely distributed as the palmettoes.

Collecting on land also has its hazards. Shortly after his first few trips ashore at Ascension Bay, Dr. Clarke developed the most severe case of "poison ivy." This time he was having a "taste" of our Barbuda experience of the previous year. His hand and lower forearm became painfully swollen, inflamed, and blistered, nor did his face and neck escape. In hacking his way through the brush he must have come in contact with the sap of a shrub related to our old friend the cashew nut (family Anacardiaceae, genus Comocladia), not uncommon in the thickets and scrubby forests of some of the drier areas of the Caribbean and in Mexico, as in Barbuda. The juice of all species of the genus is extremely poisonous, and of some so corrosive that in parts of the West Indies it is used to cure ringworm and to destroy warts, but such use can be dangerous. Several weeks elapsed before the attack subsided and Dr. Clarke could work in comfort and without endlessly renewed wrappings of paper towels and applications of calamine lotion, of which fortunately we had a good-sized bottle along. It is to be recommended for one's tropical American medicine chest.

The great mangrove swamp area in Ascension Bay must be several square miles in extent. In a recent account dealing with mangroves, and this swamp in particular, which Dr. Daiber published in the Estuarine Bulletine (Univ. Delaware, vol. 5, No. 2, June 1960), he remarked that "the trees, spread out into depths of water where young seedlings could no longer become rooted to the bottom...so the mangrove front was being advanced by the elongation of prop-roots rather than by new seedlings.

No matter what the business or pleasure that takes you to Yucatan, you will find it humanly impossible to escape the lure of Mayaland. To see something of what yet remains, in part restored, of that former most advanced of native American civilizations is a temptation not to be denied; at least it was not by the members of our primarily biological expedition.

So it came about that when Dr. Daiber had completed his mangrove swamp study, we headed north skirting the coast at this time on our way back to Cozumel. We had been intrigued by two brief bits of information in the U. S. Navy's Hydrographic Office Sailing Directions for this part of the world (the italics and bracketed insertion are mine):

Salta Iman (Kilbride Cliffs) are conspicuous as they are the only cliffs along this [otherwise low, flat, and densely wooded] coast. They are about 80 feet high and front the coast for about three miles. At their northern end are the ruins of a large square watchtower.

Tancah, about 4 miles north-north eastward of Salta Iman, is a small settlement that may be identified by a white sandy beach that forms a break in the otherwise slightly elevated land. A small stone temple on a truncated pyramid, overgrown with vegetation, is conspicuous and stands about $\frac{1}{2}$ mile inland of the settlement. There is a small pier at the settlement.

Because of the pier and its promise of landing facilities, Tancah became our next objective. But well before Tancah, we glimpsed that "large, square watchtower" atop the Kilbride Cliffs gleaming white in the

morning sun, commanding attention! As seen from the sea, it is as simple of line, and as impressive in appearance, as the Lincoln Memorial in Washington.

The formerly temple-crowned, overgrown pyramid at Tancah is no longer visible as such from the sea. It remains little more than a heap of stones and rubble hidden under a tangle of trees and undergrowth. So, on to Tulum by jeep! This was generously made available to us by Señor Jorge Gonzales A. of Tancah who also guided us to Tulum. We were not disappointed in this first opportunity to see what the Mayan architects had wrought on the site of that strategically and scenically placed city, built some years before the turn of the sixth century of our Christian era. A stela found at Tulum carries an authenticated Mayan date corresponding exactly with our A.D. 564.

The Castillo, or principal temple, faces the setting sun. A 30-foot high stairway, as steep as most of those constructed by the Mayas, rises 25 feet to the temple platform. The height of the entire structure from ground level approaches 40 feet. From the seaward side of the temple platform an entrancing vista greets the eye from north to south. Bright green palms, other trees and vegetation line the shore and top the cliffs; stretches of golden yellow beach swing north and south far beyond the rocky shore at the foot of the cliff upon which the Castillo is perched. Beaches and rocky shores are lapped by pastel-green waters indicate of inshore shoals and reefs. As the depth offshore increases, the sea takes on, more and more, a richer, darker, deeper blue. At the distant horizon line it meets the crystal clear, bright azure of the overhead sky. All

ornaments of gold and jade, the brilliant trappings and gorgeous feather headdresses of the coppery-hued Mayan priests who once officiated here. For sheer beauty, artistic composition, and "peace of mind," it is a panorama unsurpassed in this world. One feels as though he would like to sit there and "drink" it in forever.

Given this wonderful setting, the modest Castillo and the lesser temples of Tulum do not suffer in comparison with the far greater, finer finished, and, in truth, more monumental buildings we saw some days later at Chichén Itzá and Uxmal.

One would have to be unimaginative and uninspired not to feel some slight stirring to do a book on the Mayas, despite the many fine ones that have been written about their marvelously unique "acropoli" (citadels, so to speak, within which their temples stand).

Tulum with its stone wall, the central portion of which is 20 to 25 feet high and about as wide at the base, and nearly 2,400 feet long, was more citadel-like than either Chichén Itzá or Uxmal, but acropoli they are nonetheless.

The Castillo at Chichén Itzá (Fig.) is the most imposing of the many temples in this holiest of the Mayan cities in its day. Its base covers almost an acre of ground. The overall height, including the building on its summit, is about 100 feet. The four stairways approach 44 feet in greatest width and rise at an angle of 45 degrees. Being a little less steep than the slope of the sides of the pyramid, the foot of each stairway stands out beyond the pyramid's baseline. The individual steps are about 10 inches wide with risers of 11 inches. There are 91 of these steps to each stair. Added together they total 364 (4×91); which number

plus one for the upper platform equals 365; the number of days in the solar year. Each face of the pyramid rising in 9 terraced steps, is divided midway by its stairway. This results in 18 sections corresponding to the 18 months of the yearly Mayan calendar. On each pyramid face can be counted also 52 "panels," none too distinctly marked in the photographs, which in number equal the number of years in the Toltec cycle, or phase of the Mayan civilization at the time. How coincidental is the correspondence of the number of these panels with the weeks in our calendar year?

Our guide to the ruins, Felipe Castillo, called to our attention the fact that the stairways are actually wider at the top than at the bottom, a device here employed by the Maya architects to overcome the otherwise apparent convergence of the sides of the stairs in visual perspective had they been built truly parallel. This greater width at the top of each staircase is not apparent in frontal view. Only in an angle "shot" is it apparent. (Fig.)

The pyramid, and the temple facing north on its upper platform, are not precisely oriented with respect to the cardinal points of the compass. There is a slight deviation east of north. In the light of the known competence of the Maya astronomers, could it have been purposeful and be related to some recurring celestial phenomenon not yet correlated with this deviation?

On revisiting the Castillo early the following morning, I could not help but notice the sharply defined triangular shadows cast by the west

"rail" or balustrade of the north stairway across the terraces of the pyramid by the rising sun. The thought came to mind that they may well bear some relation to the passage of time perhaps as may have been marked on the former stucco facing of the terrace panels. Could the Castillo also have functioned as a monumental sundial--an astronomical clock? It is conceivable that the Mayas built into that great pyramid more practical usefulness, as well as more symbolism, than the archaeologists have so far turned up.^{3/}

^{3/} The scale model of the Chichen Itza Castillo gracing the Museum's Hall of Latin American Archeology is not quite true to life. The sides of its stairways are truly parallel, not farther apart at the top than at the bottom; and there are 90 steps instead of the 91 said to be on the original. Other interesting items bearing on Maya history and life are to be found in this same hall.

Chichen Itza (translated: "The mouths or openings of the 'wells'" (cenotes) of the Itza, the Mayan people who lived in and about, and who originally founded this holy city) in its entirety is so vast that no one book, and there are many, can ever completely encompass its history, its past glory, or all that has been found or yet may be discovered there, architecturally and archeologically.

Other than the dominating Castillo, I shall mention but two other structures, the so-called "observatory," El Caracol, and the great ball court. The Spanish name for the former, El Caracol, the Snail, derives its name for the winding stairway within the circular tower-like portion of this 75-foot high structure. Round buildings were rarities in the

Mayan world and this one, resting upon a rectangular platform, 200 x 240 feet, is unique among the Chichen Itza buildings. Evidence that it may have been used as an astronomical observatory is scanty, but the Carnegie Institution archeologists in the course of their restoration of the building did establish the fact that a line of sight-through openings in the tower wall bisects the sun on March 21 and again on September 21, at the vernal and autumnal equinoxes, respectively.

Personally, I was most impressed by the great ball court, one of the six or more reported from the Chichen Itza area. It is one of the most remarkable buildings in all Mayaland, and the largest of all ball courts ever put up by the Maya, Old or New Empire (A. D. 320-987 and A.D. 987-1527 respectively). It was more than an athletic field or sports arena for it undoubtedly served also as a place of assembly. Five thousand people can be accommodated within and on its walls.

Overall, measurements are 545 feet long by 225 feet wide; within the "temples" at either end, about 480 feet long. The "playing field" itself, apart from low lateral terraces, is 272 feet long by approximately 120 feet wide. The temple at the south end is an 80-foot wide structure. The one at the northern end is smaller, perhaps 25 feet wide. It is also colonaded, a "dais" perhaps for seating important functionaries. No public address system was needed to reach the ears of anyone of the multitude that might be called together in the confines of the court, for it is so constructed that the human voice carries its full length from one temple to the other, without undue effort, as clearly as a bell. We know

because we tried it. As marvelous, too, is the echo that travels back and forth between the side walls, a distance of 120 feet or more. Clap your hands smartly and the echo comes back, 18 times repeated in gradually diminishing volume. This, we tried too. Though we did not count them all, the echoes were often enough repeated so that we accepted as correct our guide's statement as to the number.

The Chichen Itza Ball Court certainly must rank as one of the acoustic wonders of the world. Brilliantly conceived, when one realizes that it served also as a great, roofless auditorium, its marvelous acoustic properties can be no accident of design, or of construction. The priests and the architects of Mayaland knew what they were about in those early days when it came to acoustics, art, and architecture!

The two days we spent at Chichen Itza included visits to the Temple of the Warriors and the thousand columns, the Nunnery, and a host of lesser buildings. Regrettably we had even less time at Uxmal with its outstanding House of the Governor and its towering steep-sided House of the Magician. This pyramid is unique in that its base is elliptical in outline, 240 by 160 feet. It rises 80 feet to the upper platform, which is crowned by a 20-foot high temple. Uxmal is more truly Mayan in its architecture than Chichen Itza where the Mexican Toltec influence, A.D. 950-1200, left its impress. Chichen Itza, according to Tozzer, "had a longer recorded history, ancient or modern, in all America." (See also footnote 3/.)

The late Sylvanus G. Morley, and his colleagues formerly with the

Carnegie Institution in Washington have published some very intriguing accounts of the Mayas and their works, but no student or authority on the Mayas ever produced a more incisive and appreciative appraisal of their cultural achievement than Morley:

"In appraising the civilization of any people, the true measure of their attainment is not the sum total of their achievement compared with the achievements of other peoples, but rather their entire accomplishment counted from their own cultural zero.

"Thus the construction of the Empire State Building with all the mechanical devices, modern machinery and building materials available to its builders is much less an achievement than the erection of a Maya temple of far less size and complexity, but built entirely without metal tools, structural steel, cement, hollow tile, machine-sawn and dressed stone, compressed air, electricity, gas, steam, and elaborate hoisting machinery. The former was built with the knowledge of the ages behind its builders; the latter without metal tools, beasts of burden, either animate or inanimate, or even knowledge of the principles of the wheel.

"To find a condition in the Old World comparable to the Maya cultural scratch, it is necessary to go far back in human history to early Neolithic times when man's knowledge and utensils were similarly restricted. On this primitive horizon only may the Maya civilization be fairly compared with other civilizations of antiquity both in the Old World and in the New.

"When the material achievements of the ancient Maya in architecture, sculpture, ceramics, the lapidary art, feather-work, cotton-weaving and

dyeing are added to their abstract intellectual achievements--invention of positional mathematics with its concomitant development of zero, construction of an elaborate chronology with a fixed starting point, use of a time-count as accurate as our own Gregorian Calendar, knowledge of astronomy superior to that of the ancient Egyptians and Babylonians--and the whole judged in the light of their known cultural limitations, which were on a par with those of the early Neolithic Age in the Old World, we may acclaim them, without fear of successful contradiction, the most brilliant aboriginal people on this planet." ^{4/}

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This quotation is taken from Morley's Guide Book to the Ruins of Quirigua, "Carnegie Institution of Washington Supplementary Publication No. 16, 1935 (pp. i-vii, 1-205). He who wishes to "pursue" the Mayas further should read Dr. Morley's "The Ancient Maya," Stanford University Press, 1946 (pp. i-xxxii, 1-520), which has gone through several editions, the latest of which is dated 1956; also John Eric S. Thompson's "The Rise and Fall of Maya Civilization," University of Oklahoma Press, 1954 (pp. i-xii, 1-287), and Alfred M. Tozer, "Chichen Itza and its Cenote of Sacrifice," Memoirs of the Peabody Museum, vol. XI and XII, Cambridge, 1957 (pp. i-viii, 1-230 and 231-316). These works contain excellent and classified bibliographies and are well illustrated.

THE COUNT OF SPECIMENS COLLECTED

After Tulum, Chichen Itza, and Uxmal, the rest of our Yucatan adventure was anticlimax. We subsequently collected along the beach and rocky reef at Tancah, and over shoals and marshes and coral growths at the south end of Cozumel. It is too early yet to say what we got in species and in rarities beyond the few already mentioned. The bulk of our material will have to await the work of the specialists who will identify and report upon it.

In the course of our five weeks in Quintana Roo waters, 117 collecting stations were established, mostly in the marine littoral, and some 14 plankton samples taken with tow-and-dipnet, the latter with aid of a submerged electric light over the ship's side. Dr. Clarke at 20 different localities collected insects along with other terrestrial arthropods and mollusks, and on Cozumel, in addition, a number of bats.

The number of marine invertebrates obtained may well total 10,000. Many of these are small, or even of microscopic size. Over 500 specimens of fish were caught, and something in excess of 5,000 insects and terrestrial arthropods were also brought back. Scientifically this Yucatan expedition may be counted as one of the more productive of the recent Bredin Caribbean expeditions.

THE WEATER

Although the rainy season, with 50 to 60 inches of rain, runs from December to early May, and occasionally to mid-April, fine clear weather proved the rule with us this year. The rains we did have seemed few and far between, but those that we experienced were proverbial tropical down-pours, cloudbursts I want to say, for one got thoroughly soaked and chilled in them. Most of the time there were strong persistent winds, 70 per cent of the time from the N. E. the sailing directions tell us, about half the time 10 to 12 miles an hour. A quarter of the time the winds ranged up to 20 or more miles an hour, but now and then a fierce squall would burst in suddenly from the north or west with winds up to 40 or more miles an hour --our "bonanza" for example. We found the days quite warm, in the low

80's in the shade, but the nights seemed always cool on deck due to the prevailing easterly trade winds. Though the recorded extremes of temperature for this coast are said to range from 39° to 107° , the average maximum is around 80° , the average minimum around 60° .

A BIT OF HISTORY

Ascension Bay, our chief collecting ground, was discovered by the Juan de Grijalva Expedition--4 ships, 200 men--on Ascension Thursday, 1518. This expedition was also the first to see Tulum--as we first saw it--from the sea (Fig.). Grijalva was on his way south along the east coast of Yucatan following his discovery of Cozumel, May 3, 1518. On May 7 he sailed over to the coast of Yucatan where he passed, as his chronicler recorded, "Three large towns separated from each other by about two miles. There were many houses of stone, very tall towers, and buildings covered with straw..."

"We followed the shore day and night, and the next day toward sunset we perceived a city or town so large, that Seville would not have seemed more considerable, nor better; one saw there a very large tower; on the shore was a great throng of Indians, who bore two standards which they raised and lowered to signal us to approach them; the commander did not wish it. The same day we came to a beach near which was the highest tower we had seen and one discerned a very considerable town.... We discovered a bay so large that a fleet might enter. It was lined with wooden buildings set up by fishermen."

Authorities are generally agreed that this "highest tower" was the Castillo at Tulum. "The large city or town" to my mind was the "residential" part of Tulum. At Tancah undoubtedly was located one of the other three towns, mentioned in the quoted account, and the great bay, our Bahia de Ascension.

Grijalva's expedition was the second of two outfitted in those early days at Santiago de Cuba for a search to the westward for slaves and/or gold. To the first of these headed by Francisco Fernandez de Cordoba is to be credited the discovery of Isla Mujeres in 1517.

Though the earliest beginnings of what was to become the great Maya civilization antedated the birth of Christ by several thousand years, the first Europeans to encounter the Mayas, were the survivors of the wreck of an ill-fated Spanish ship on its way from Darien to Santo Domingo that foundered on a reef off Jamaica in 1511.

Of the 19 who escaped 7 perished in the course of the 14 days they were at sea in an open boat at the mercy of the prevailing easterly trade winds that carried them to the coast of Yucatan.

IN CONCLUSION

Although Mr. Bredin intended to give the expedition a full week of collecting in the Cayman islands, an unforeseen change in airplane schedules between Cozumel and Merida disrupted our plans. In consequence, we were vouchsafed but two days in Georgetown, Grand Cayman, before our charter expired on May 5. These days were largely occupied in getting our collections and collecting gear packed for shipment home. Due to leave for Miami

on the 6th of May, because of minor airplane trouble we did not get away until the morning of the 7th. The 9th saw us back at work at the Museum, and Dr. Daiber at the University of Delaware, the day of our return to Washington being Sunday.

ACKNOWLEDGMENTS

Of the many to whom the Smithsonian Institution owes so much for the happy conclusion of a successful voyage to Quintana Roo--a still too little-known corner of the world--only a few can here be named: First of all, Mr. and Mrs. J. Bruce Bredin, who suggested, and made possible the expedition; Dr. Enrique Beltran, of the Secretaria de Agricultura y Ganaderia in Mexico City, who so wholeheartedly supported our objectives before the Mexican authorities; Pablo Bush Romero, who introduced us to Admiral Armando Canizares, chief of the naval district embracing Quintana Roo, who in turn gave us much more useful information about local weather conditions and navigational hazards; Mr. Neil L. Parks, our ever-helpful Consul in Merida; Dr. Raymund Zwemer, Deputy Science Advisor to the Department of State in Washington; and last but not least, throughout the voyage, my ever-industrious, cooperative, and congenial fellow members of the scientific staff of the expedition. We are also deeply indebted to our Embassy staff in Mexico City, to the Federal Government of Mexico, to many of the residents of Isla Cozumel, particularly Father James Nagle, S.J., who interested the boys in his school in securing small stingrays in quantity needed by Dr. Daiber for his elasmobranch studies, and to Mr. Robert S. Fuller of Grand Cayman, a correspondent of the Museum, whose

"Shell Shack Museum" we visited, and who took us on the one brief collecting excursion we were able to get in before we left the island.

Photographs here reproduced were taken mostly by Dr. Daiber, and in smaller part by Dr. Clarke and myself.

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THE 1960 SMITHSONIAN-BREDIN MAYA-LAND EXPEDITION

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Following the 1959 Caribbean expedition, the Maya-land expedition was organized primarily for the purpose of sampling the ^{relatively unknown} marine fauna and the insect life of the east coast of the Mexican Territory of Quintana Roo, Yucatan, and the nearby islands of Mujeres and Cozumel. The expedition remained in the field from March 26 through May 6, 1960.

From this seldom visited and very considerable stretch of coast the United States National Museum has received over the years little in the way of specimens, marine or terrestrial. Hence our keen interest to have a go at it on this sixth of the expeditions that Mr. and Mrs. J. Bruce Bredin, of Wilmington, Delaware, have sponsored for the Smithsonian Institution, ^{and} their fourth to the Caribbean.

Although the former U. S. Fish Commission Str. Albatross had investigated the deeper waters at the north end of Cozumel and the Carnegie Institution had studied the terrestrial and cave faunas, the marine littoral had hitherto received but scant attention.

All that the Museum possessed in the way of seashore life from the waters along the east coast of Yucatan were several small lots of marine invertebrates picked up by friends of the Institution prior to 1940. The best remembered collector is Ralph Elliott, of the United States Department of Agriculture, formerly agricultural attaché with our Embassy in Guatemala.

In the course of his 1938 cruise in his 45-foot ketch, Trail Star, he obtained several decapod crustaceans from the very area that we visited this year. As was to be expected, the material from this seldom-collected east coast of Yucatan yielded a number of new records of occurrence, as well as extensions of geographic range. Dr. Chace, in his report on described new species from this area.

Five zoologists comprised the scientific^{staff} of the present expedition: Dr. Waldo L. Schmitt, Research Associate, Smithsonian Institution, marine biologist especially interested in shrimps and crabs and their close relatives; Dr. J. F. Gates Clarke, Curator of Insects, U. S. National Museum, an authority on economically important tiny moths (Microlepidoptera - "micros" for short); Dr. Harald A. Rehder, Curator of Mollusks, U. S. National Museum, who plans a report on the marine shells of the Quintana Roo littoral; Dr. Franklin C. Daiber, Professor of Zoology, Department of Biological Sciences, University of Delaware, ichthyologist and estuarine ecologist, whose chief concern on this occasion was an ecologic study of a mangrove swamp and its associated fish population; and Dr. Edward L. Bousfield, Chief Zoologist, National Museum of Canada, Ottawa, a carcinologist specializing on barnacles and amphipod crustaceans, especially the beach-inhabiting and terrestrial forms. Mr. Bredin and his brother-in-law, Mr. Ernest N. May, also of Wilmington, took part in the activities of the expedition during

the last week of April, visiting the Maya ruins of Chichén Itzá and Uxmal near Merida, and the island of Cozumel with three members of the field party--Daiber, Rehder, and Schmitt. The others--Bousfield and Clarke, had to return home on April 24 because of other commitments.

Five weeks and a day marked the actual span of this Yucatan expedition from the time we quit the restless, open roadstead of Progreso on March 26 until we left Mexican waters on April 30 for Georgetown, Cayman Islands, where, after a 74-hour passage, we parted company with our chartered 70-foot auxiliary schooner on May 6, to return to Washington.

In Progreso the purchase of supplies beyond those obtained in Miami and an additional and heavier anchor that the winds here warned us might be needed left very limited time for collecting. This was accomplished chiefly by Drs. Clarke and Daiber in and about the nearby lagoon and mangrove swamp. Some shells were picked up by Dr. Rehder, who scoured the beaches. At Isla Mujeres, our next port of call, four profitable days were spent, March 28 through 31, on reefs, shoals, turtle grass flats, and stands of mangroves which were very reminiscent of the Florida Key area in faunal aspect. Corals, gorgonians, sponges, mollusks, crustaceans, fish, and algae were gathered in fair quantity within the spacious harbor and along the outer reaches of the island of Cozumel. We left for San Miguel, island of Cozumel, shortly after sun-up April 1 and dropped anchor off the pier there the same evening at half past six.

of this ~~PRAS~~ ^{PRAS} cruise,
The
It was off San Miguel that we had ~~our~~ ^{one} first adventure, and ~~a~~
~~one~~ quite unanticipated. We were bent on fishing for deepwater mollusks with the unique rattan traps that John Finlay had devised, and to which he introduced us on the 1958 Smithsonian-Bredin Caribbean Expedition. Dr. Rehder and I wanted to "fish" the Cozumel channel where the 100-fathom curve was only a half-mile off shore. The current here runs swiftly, all of 2-1/2 knots, but with plenty of line, as John advised, and what we deemed sufficient weight, two traps were put over late one afternoon within sight of one another to facilitate locating them before sun-up the next morning. In the half light of morning the channel and its unquiet sea were none too inviting, ~~and~~ the current appeared ever so much more swift than the evening before, and the large, well-inflated automobile tires that buoyed our lines were not where they should have been. We started to cruise in circles, working more and more to the northward of our bearings on the San Miguel light and pier in the direction of the current flow. We persevered to no purpose. Having apparently miscalculated the strength of the current, we seemed to have lost our gear.

True adventures are never planned in advance, except perhaps in movie scripts. Ours was suddenly thrust upon us with the utter failure of the outboard motor which powered our dinghy. It refused to start, no matter how hard our crewman, Hal, worked on it. Just when one needs it most the typical charter-boat outboard seems to let one down. Here we were out in this 2-3

knot current being borne swiftly away from "home" and breakfast. Though we spelled one another at the oars, we were drifting north more rapidly than we were making headway toward shore. Already we had visions of missing the north end of Cozumel, and of a future of some uncertainty. Some 4 or 5 miles above San Miguel, Ing. Raul Gonzalez Rivero was building his "Cabana del Caribe," an attractive resort hotel, motel style, with cottages, dining hall, bar, swimming pool, and playa. The sun was well up by this time and the resort's boatman was at work on shore. Quite providentially he looked out to sea and noted our predicament--helplessness is a better word--and in less time than it takes to tell he had jumped into Gonzalez' runabout and before long was tossing us a towline. It was well toward 9 o'clock before we got "home" again. The affair could have turned out less happily had the young man in question been less observant, or less keen of sight.

To better express our appreciation of the rescue, we not only filled up the runabout's gas tanks and rewarded her "captain," but we journeyed up to the Cabanas that very same midday to thank the proprietor, and to enjoy dinner at his establishment. By so doing we became acquainted with Mrs. Emmett Gowan. Her husband, the resort's fishing guide, is an exceptionally well-posted man on local conditions, people, and game fishing. As he was away that day, we invited the Gowans to have lunch aboard our schooner at their early convenience. Two days later, Mrs. Gowan

being unable to come, Emmett brought along a ^{personal} good friend, Tony Halik, free-lance photographer, who then was roaming the world for Life Magazine. Long will be remembered the day, April 4, 1960, that they came aboard for lunch. — our second Quinny Roo adventure

Our amidship cabin was a snug fit for the seven of us, but all the more intimate for rubbing elbows, telling fish tales, talking of navigational hazards, and discussing the Boca de Paila camp over which Emmett presided on the mainland. Quite happily we had come to dessert and coffee, but just as the canned peaches were being passed, the gentle rhythm of the ship's riding at anchor was suddenly broken. From out of nowhere, utterly without warning, a fiercely bitter gale, driving shoreward, bore down on us, one of those violent gusty westerlies with 40-mile-an-hour or better winds, a blow that the native people hereabouts call a "bonanza."

Desert and coffee were forgotten in the urgency and commotion of the moment. ^{the} heaving and straining ~~of~~ Gowan's plexiglass twin-outboard threatened at any moment to snap its painter. There was not a second to lose. Without as much as by-your-leave, Gowan and Halik tumbled aboard their light motorboat, cast off, and scudded down the coast for Caleta Bay, the only natural small boat shelter on the island, 4 miles to the south, shallow but safe and landlocked.

Aboard the schooner, we, too, had to be on the jump. There was the engine to start and a dragging anchor and two dinghies to get aboard. The violent on-shore gusts of wind threatened

us with the same dire fate that a similar squall, just a few months before, had meted out to an older and larger schooner now piled up with broken back on the shoals between our insecure anchorage and the shore.

"It is an ill wind that blows nobody good." This rather violent squall got us under way for Espíritu Santo and Ascensión Bays with more expedition than we had previously thought possible. From an inspection of the Hydrographic Office charts we selected these bays as promising collection grounds for the next two weeks. On this occasion, however, we could only briefly reconnoiter them. On arrival at Espíritu Santo, the captain came to us with what he called a "problem,"--virtually empty fuel tanks! There was nothing left but to hasten back. We were able, nevertheless, to see enough of both bays to agree with Dr. Daiber that Ascensión Bay was the better place to pursue his ^{planned} ecologic study of a mangrove swamp.

So good did the weather prove to be on this unscheduled return to Cozumel that we tried to make the most of it. After refuelling on April 8, we ran up to have a look at the extensive bank off the north end of the island, an exposed, indifferently charted area that the captain had been fearful of tackling before.

Finding a favorable anchorage in those coral "infested" waters calls for an alert lookout. Too late did ours, perched up on the foremast, call down that we were hard upon a huge coral head too near the surface for a vessel drawing 9 feet to clear. Despite the helmsman's most strenuous efforts, the port bow

Our third adventure this time more of a hisad-
 slammed into that immovable mass of coral rock. The mighty thump, the ominous grinding, and the shudder that ran through the ship not only brought us up short, but made us fear the worst. There was a rush forward on deck, and below, to check the damage. With the use of an aqualung we were able to determine that the nasty gash 3 feet below the waterline was only skin deep and that our cruise had not been brought to an untimely end.

Working along the shore of the large lagoon at the north end of the island, Dr. Clarke ^{discovered} hit upon a unique and an exceedingly productive method of gathering in the small beach-life commonly found in and under the wrack left by wave and tide on many shores. He threw some of this stranded flotsam in the water close by. Everything alive in it, apparently aware that it would soon become part of some hungry fish's meal, makes all haste to get out of the "drink." Should the wet trouser leg of collector who started all this be closer at hand than the beach, it becomes crowded with little arthropods frantically seeking refuge--insects, myriapods, and beach-fleas. Thus, it becomes an easy matter to pick them off with forceps or scrape them up with the lip of a bottle or vial. It ^{proved to be} is a superlative method. Another way of capturing these ubiquitous creatures is to bury 2 to 3 inches deep a not too shallow pan with about an inch of 5 percent formaldehyde solution in the bottom, so that the edge of the pan is level with the surface of the sand. Leave it out over night and the next morning you will be rewarded with a rich haul of specimens. Many have stumbled or tumbled in in the course of their night time foraging.
 (at night)

April 10 saw us back in Ascensión Bay. Quite shallow for the most part, like Espíritu Santo it is somewhat larger, perhaps 8 miles across the entrance and varying from 5 to 11 miles wide inside. It extends back into the land some 16 miles. This great bay has about everything a marine biologist could want in the way of good collecting grounds: a barrier or fringing reef, coral studded flats and muddy shoals, turtle grass in abundance, rocky shores, tide pools, lovely beaches, lagoons, extensive mangrove swamps, deep water not too far outside the reef, and, for tropical insect life, a variety of habitats in the xerophytic "bush" on shore.

The first biological surprise was the swarming of the little dark, brownish-looking, blue-speckled jellyfish that were hastening by the ship the morning of April 14. Literally thousands of half-inch high, slightly wider, "thimbles" seemed to be spinning clockwise, rushing along in several streaks or bands. None of us had ever seen anything like this species of jellyfish, Linuche unguiculata, which is without tentacles and has a scalloped margin. We learned, however, that it forms swarms miles in extent in the Bahama-Florida region in the spring. When the animals mature in April, they rise to the surface in immense numbers. The ripe female gonads are slate-colored or blue-gray perhaps, the male a yellowish brown. The eggs are discharged and fertilized in the sea about 8 p.m., after which the jellyfish sink to the bottom to die. The species goes through an alternation of generations. The egg develops into a little sessile antlike organism from which the larval jellyfish are pinched off, or shed, by a process known as strobilization, to become free-swimming and to

grow up to maturity the next April, then to repeat the cycle. I do not know if Linuche swarms every year, but this Ascensión Bay swarm is the first I have ever witnessed, though I have cruised the Caribbean several Aprils in succession. Though they were reported most widely distributed in tropic seas, the only specimens in the Museum heretofore were from off the coasts of Cuba, the Bahamas, and Florida, drifting in the Gulf Stream.

Of equal interest was the ^{sighting} occurrence on the same day of three specimens of a delicately pastel-tinted purple, 8-tentacled jellyfish with a "bell" about 1-1/2 inches high and nearly 2 inches in diameter--Pelagia cyanella. This ^{is} likewise a tropic-sea form, known from around the world, and also said to swarm at times in considerable numbers. In this species the development is direct. The fertilized egg develops into a free-swimming larval form, the planula, which grows to become a mature Pelagia in turn.

A second
 Still another Ascensión Bay surprise was turned up by our indefatigable Dr. Clarke. With his set-up for collecting flying insects at night (an expanse of white sheeting illuminated by two strong Coleman lights) he captured a single specimen of a micro found previously only in the southern States, where it is not uncommon and where its larvae feed on palmettoes. The larval habit is undoubtedly the same here, for palmettoes are also common in Yucatán. In the American tropics this bizarre-looking moth (Fig.) is probably as widely distributed as the palmettoes.

Collecting on land also has its hazards. Shortly after his first few trips ashore at Ascensión Bay, Dr. Clarke developed the most severe case of "poison ivy." This time he was having

a "taste" of our Barbuda experience of the previous year. His hand and lower forearm became painfully swollen, inflamed, and blistered, nor did his face and neck escape. In hacking his way through the brush he must have come in contact with the sap of a shrub related to our old friend, the cashew nut (family Anacardiaceae, genus Comocladia), not uncommon in the thickets and scrubby forests of some of the drier areas of the Caribbean and in Mexico, as in Barbuda. The juice of all species of the genus is extremely poisonous, and of some is so corrosive that in parts of the West Indies it is used to cure ringworm and to destroy warts, but such use can be dangerous. Several weeks elapsed before the attack subsided and Dr. Clarke could work in comfort and without endlessly renewed wrappings of paper towels and applications of calamine lotion, of which, fortunately, we had a good supply. (Calamine lotion should be included in every tropical American medicine chest.)

The great mangrove swamp area in Ascensión Bay is surely several square miles in extent. In an account (Estuarine Bulletin, Univ. Delaware, vol. 5, No. 2, June 1960) dealing with mangroves and this swamp in particular, Dr. Daiber remarked that "the trees spread out into depths of water where young seedlings could no longer become rooted to the bottom...so the mangrove front was being advanced by the elongation of prop-roots rather than by new seedlings. There was considerable organic fill among the prop-roots, to such an extent that only at high tide was it covered. Waterways up to forty and fifty feet deep wound and twisted among the trees. The accumulated organic matter imparted a tea color to the water.

"The most obvious feature about the swamp at Ascensión Bay was the large number of dead mangroves; among the dead trees were many living mangroves, particularly along the edges. They had been dead for some time--the bark was off the trees, and the branches were dry and brittle. Certain dead branches served as cormorant roosts. Cormorants were the most common birds in the area, subsisting on fish they caught by diving from the trees into the shallow water.

"Fiddler crabs and snails are numerous on the mud surface and on mangrove roots, while mud oysters hang singly and in clusters from the lower branches. Amphipods swarm about the festoons of algae and sponges suspended from the prop-roots. Many kinds of bright-colored fish glide and hover about the submerged roots and fallen branches. There are whole groups of fishes that are less obvious: blennies, gobies, cyprinodonts, and others, dark colored and blending with the tannin-stained mud.

"Perhaps one of the most intriguing sights was the clusters of two and three species of sponges attached to the mangrove roots. In the crevices among the sponges there were a variety of shrimps, amphipods, and crabs. Inch-long, greyish-colored flat forms with dark markings were observed gliding about over the surface of the sponges, while an occasional fish would be revealed if the sponge mass was broken open. Here was a miniature habitat surrounded by, and dependent upon, the water for its existence but relatively independent of what went on elsewhere. In and among the sponges certain small animals had found a place to hide, to feed, and to produce their kind."

MAYA-LAND

No matter what the business or pleasure that takes you to Yucatan, you will find it impossible to escape the lure of Maya-land. To see something of what yet remains, in part restored, of that former most advanced of native American civilizations is a temptation not to be denied; at least it was not by the members of our primarily biological expedition.

So it came about that when Dr. Daiber had completed his mangrove swamp study, we headed north, skirting the coast (at this time on our way back to Cozumel. We had been intrigued by two brief bits of information in the U. S. Navy Hydrographic Sailing Directions for the East Coasts of Central America and Mexico (H.O. Pub. 20, Fifth edition, 1952, p. 198):

"Salta Iman (Kilbride Cliffs) are conspicuous as they are the only cliffs along this [otherwise low, flat, and densely wooded] coast. They are about 80 feet high and front the coast for about three miles. At their northern end are the ruins of a large square watchtower.

"Tancah, about 4 miles north-northeastward of Salta Iman, is a small settlement that may be identified by a white sandy beach that forms a break in the otherwise slightly elevated land. There is a small pier at the settlement."

Because of the pier and its promise of landing facilities, Tancah became our next objective. But well before Tancah we glimpsed that "large square watchtower" atop the Kilbride Cliffs

gleaming white in the morning sun, commanding attention. As seen from the sea, it is as simple of line, and as impressive in appearance, as the Lincoln Memorial in Washington.

The formerly temple-crowned, overgrown pyramid at Tancah is no longer visible as such from the sea. It remains little more than a heap of stones and rubble hidden under a tangle of trees and undergrowth. So, on to Tulum by means of a jeep generously made available to us by Señor Jorge Gonzales A. of Tancah, who also guided us to Tulum. *Here,*

We were not disappointed in this first opportunity to see what the Mayan architects had wrought on the site of that strategically and scenically placed city, built some years before the turn of the ^{seventh} ~~sixth~~ century of our Christian era. A stela found at Tulum carries an authenticated Mayan date corresponding exactly with our A.D. 564.

The Castillo, or principal temple, at Tulum faces the setting sun. A 30-foot high stairway, as steep as most of those constructed by the Mayas, rises 25 feet to the temple platform. The height of the entire structure from ground level approaches 40 feet. From the seaward side of the temple platform an entrancing vista greets the eye from north to south. Bright green palms, other trees and vegetation line the shore and top the cliffs; stretches of golden yellow beach swing north and south far beyond the rocky shore at the foot of the cliff upon which the Castillo is perched. *One* Beaches and rocky shores are lapped by pastel-green waters, indicative of inshore shoals

and reefs. As the depth offshore increases, the sea takes on, more and more, a richer, darker, deeper blue. At the distant horizon line it meets the crystal clear, bright azure of the overhead sky. All that is lacking to complete the rich spectrum of color are the bright ornaments of gold and jade, the brilliant trappings and gorgeous feather headdresses of the copper-hued Mayan priests who must once have officiated here. For sheer beauty, artistic composition, and "peace of mind," it is a panorama unsurpassed in this world. One feels as though he would like to sit there ^{to} and "drink it in" forever.

With this wonderful setting, the modest Castillo and the lesser temples of Tulum do not suffer in comparison with the far greater, finer finished, and more monumental buildings we saw some days later at Chichén Itzá and Uxmal.

One would have to be unimaginative and uninspired not to feel some slight stirring to do a book on the Mayas, despite the many fine ones that have been written about their marvelously unique "acropoli," citadels so to speak, within which their temples stand.

Tulum, with its stone wall, the central portion of which is 20 to 25 feet high and about as wide at the base and nearly 2,400 feet long, was more citadel-like than either Chichén Itzá or Uxmal, but an acropolis it is, nonetheless.

The Castillo at Chichén Itzá (Fig.) is the most imposing of the many temples in this holiest of the Mayan cities in its day. Its base covers almost an acre of ground. The

overall height, including the building on its summit, is about 100 feet. The four stairways approach 44 feet in greatest width and rise at an angle of 45 degrees. Being a little less steep than the slope of the sides of the pyramid, the foot of each stairway stands out beyond the pyramid's baseline. The individual steps are about 10 inches wide with risers of 11 inches. There are 91 of these steps to each stair. Added together they total 364 (4×91); which number, plus one for the upper platform, equals 365, the number of days in the solar year. Each face of the pyramid, rising in 9 terraced steps, is divided midway by its stairway. This results in 18 sections, corresponding to the 18 months of the Mayan year. On each pyramid face can be counted also 52 "panels," none too distinctly marked in the photographs, which in number equal the number of years in the Toltec cycle, or phase of the Mayan civilization at the time. How coincidental is the correspondence of the number of these panels with the number of weeks in our calendar year?

Our guide to the ruins, Felipe Castillo, called to our attention the fact that the stairways are actually wider at the top than at the bottom, a device employed by the Maya architects to overcome the otherwise apparent convergence of the sides of the stairs in visual perspective had they been built truly parallel. This greater width at the top of each staircase is not apparent in frontal view. Only in an angle "shot" is it apparent (Fig.).

The pyramid, and the temple facing north on its upper platform, are not precisely oriented with respect to the cardinal points of the compass. There is a slight deviation east of north. In the light of the known competence of the Maya astronomers, could it have been purposeful and be related to some recurring celestial phenomenon not yet correlated with this deviation?

On revisiting the Castillo early the following morning, I could not help but notice the sharply defined triangular shadows cast by the west "rail" or balustrade of the north stairway across the terraces of the pyramid by the rising sun. The thought flashed to mind that they may well bear some relation to the passage of time perhaps as may have been marked on the former stucco facing of the terrace panels. Could the Castillo also have functioned as a monumental sundial--an astronomical clock? It is conceivable that the Mayas built into that great pyramid more practical usefulness than the symbolism that the archaeologists have so far turned up.*

*The scale model of the Chichén Itzá Castillo gracing the Museum's Hall of Latin American Archeology is not quite true to life. The sides of its stairways are truly parallel, not farther apart at the top than at the bottom; and there are 90 steps instead of the 91 on the original.

Chichen Itza, in its entirety, is so vast that no one book, and there are many, can ever completely encompass its history,

its past glory, or all that has been found or yet may be discovered there, architecturally and archeologically. The translation of this temple's name is "The mouths or the openings of the 'wells' (cenotes) of the Itzá, the race of Mayan people who lived or settled in the area and who originally founded this holy city.

Aside from the dominating Castillo, I shall mention but two other structures, the so-called "observatory," El Caracol, and the great ball court. The Spanish name for the former, El Caracol, the Snail, ^{is derived} ~~derives its~~ name from the winding stairway within the circular tower-like portion of this 75-foot high structure. Round buildings were rarities in the Mayan world, and this one, resting upon a rectangular platform 200 x 240 feet, is unique among the Chichén Itzá buildings. Evidence that it may have been used as an astronomical observatory is scanty, but the Carnegie Institution archeologists in the course of their restoration of the building did establish the fact that a line of sight-through openings in the tower wall bisects the sun on March 21 and again on September 21, at the vernal and autumnal equinoxes, respectively.

Personally, I was most impressed by the great ball court, one of the six or more reported from the Chichén Itzá area. It is one of the most remarkable buildings in all Maya-land, and the largest of all ball courts ever put up by the Maya, Old or New Empire (A.D. 320-987 and A.D. 987-1527 respectively). It was more than an athletic field or sports arena, for it undoubtedly served also as a place of assembly. Five thousand people could be accommodated within and on its walls.

Overall, measurements are 545 feet long by 225 feet wide and, within the "temples" at either end, about 480 feet long. The "playing field" itself, apart from low lateral terraces, is 272 feet long by approximately 120 feet wide. The temple at the south end is an 80-foot wide structure. The one at the northern end is smaller, perhaps 25 feet wide. It is also colonaded, a "dais" perhaps for seating important functionaries. No public address system was needed to reach the ears of the multitude that might be called together in the confines of the court, for it is so constructed that the human voice carries its full length from one temple to the other, without undue effort, as clearly as a bell. We know, because we tried it. As marvelous, too, is the echo that travels back and forth between the side walls, a distance of 120 feet or more. Clap your hands smartly and the echo comes back 18 times, repeated in gradually diminishing volume. This, we tried, too. Though we did not count them all, the echoes were often enough repeated that we accepted as correct our guide's statement as to the number.

The Chichén Itzá Ball Court certainly must rank as one of the acoustic wonders of the world. Brilliantly conceived, when one realizes that it served also as a great, roofless auditorium, its marvelous acoustic properties can be no accident of design or of construction. The priests and the architects of Maya-land knew what they were about in those early days when it came to acoustics, art, and architecture!

The two days we spent at Chichén Itzá included visits to the Temple of the Warriors and the thousand columns, the Nunnery,

7 (its)

and a host of lesser buildings. Regrettably, we had even less time at Uxmal, with its outstanding House of the Governor and its towering steep-sided House of the Magician. This pyramid is unique in that its base is elliptical in outline, 240 by 160 feet. It rises 80 feet to the upper platform, which is crowned by a 20-foot high temple. Uxmal is more truly Mayan in its architecture than Chichén Itzá, where the Mexican Toltec influence, A.D. 950-1200, left its impress. Chichén Itzá, according to Tozzer, however, had a longer recorded history, ancient or modern, than any other ^{in his} in all of America, North or South. (See footnote, p. 21).

The late Sylvanus G. Morley published some very intriguing accounts of the Mayas and their works: ^{reminds}

"In appraising the civilization of any people, the true measure of their attainment is not the sum total of their achievement compared with the achievements of other peoples, but rather their entire accomplishment counted from their own cultural zero.

"Thus the construction of the Empire State Building with all the mechanical devices, modern machinery and building materials available to its builders is much less an achievement than the erection of a Maya temple of far less size and complexity, but built entirely without metal tools, structural steel, cement, hollow tile, machine-sawn and dressed stone, compressed air, electricity, gas, steam, and elaborate hoisting machinery. The former was built with the knowledge of the ages behind its builders; the latter without metal tools, beasts of burden, either animate or inanimate, or even knowledge of the principles of the wheel.

"To find a condition in the Old World comparable to the Maya cultural scratch, it is necessary to go far back in human history to early Neolithic times when man's knowledge and utensils were similarly restricted. On this primitive horizon only may the Maya civilization be fairly compared with other civilizations of antiquity both in the Old World and in the New.

"When the material achievements of the ancient Maya in architecture, sculpture, ceramics, the lapidary art, feather-work, cotton-weaving and dyeing are added to their abstract intellectual achievements--invention of positional mathematics with its concomitant development of zero, construction of an elaborate chronology with a fixed starting point, use of a time-count as accurate as our own Gregorian Calendar, knowledge of astronomy superior to that of the ancient Egyptians and Babylonians--and the whole judged in the light of their known cultural limitations, which were on a par with those of the early Neolithic Age in the Old World, we may acclaim them, without fear of successful contradiction, the most brilliant aboriginal people on this planet."*

*This quotation is taken from Morley's Guide Book to the Ruins of Quirigua," Carnegie Institution of Washington Supplementary Publication No. 16, 1935 (pp. i-vii, 1-205). He who wishes to "pursue" the Mayas further should read Dr. Morley's "The Ancient Maya," Stanford University Press, 1946 (pp. i-xxxii. 1-520), which has gone through several editions, the latest of which is dated 1956; also John Eric S. Thompson's "The Rise and Fall of Maya Civilization," University of Oklahoma Press, 1954

*Asa Tozzer
has the
account of Chichen
Itza?*

(pp. i-xii, 1-287), and Alfred M. Tozzer's "Chichen Itza and its Cenote of Sacrifice," *Memoirs of the Peabody Museum*, vol. XI and XII, Cambridge, 1957 (pp. i-viii, 1-230 and 231-316). These works contain excellent and classified bibliographies and are well illustrated.

THE COUNT OF SPECIMENS COLLECTED

See also p. 17

After Tulum, Chichén Itzá, and Uxmal, the rest of our Yucatan adventure was an anticlimax. We subsequently collected along the beach and rocky reef at Tancah, and over shoals and marshes and coral growths at the south end of Cozumel. What we got in species and in rarities beyond the few already mentioned has been set forth by Dr. Fenner A. Chace in his report

*Will be of
to document
paper*

In the course of our five weeks in Quintana Roo waters, 117 collecting stations were established, mostly in the marine littoral, and some 14 plankton samples taken with tow- and dipnet, the latter with aid of a submerged electric light over the ship's side. Dr. Clarke, at 20 different localities, collected insects along with other terrestrial arthropods and mollusks, and on Cozumel, in addition, a number of bats.

The number of marine invertebrates obtained may well total 10,000. Many of these are small, or even microscopic, in size. Over 500 specimens of fish were caught, and something in excess

*see
check
records*

of 5,000 insects and terrestrial arthropods were also brought back. Scientifically, this Yucatan expedition may be counted as one of the more productive of the Bredin Caribbean expeditions.

THE WEATHER

Although the rainy season, with 50 to 60 inches of rain, runs from December to early May, and occasionally to mid-April, fine, clear weather proved the rule with us this year. The rains we did have seemed few and far between, but those that we experienced were proverbial tropical downpours, cloudbursts I want to say, for one got thoroughly soaked and chilled in them. Most of the time there were strong, persistent winds, 70 per cent of the time from the northeast, the sailing directions tell us, about half the time 10 to 12 miles an hour. A quarter of the time the winds ranged up to 20 or more miles an hour, but now and then a fierce squall would burst in suddenly from the north or west with winds up to 40 or more miles an hour. We found the days quite warm, in the low 80's in the shade, but the nights seemed always cool on deck because of the prevailing easterly trade winds. Though the recorded extremes of temperature for this coast are said to range from 39° to 107° , the average maximum is around 80° , the average minimum around 60° .

A BIT OF HISTORY

Ascensión Bay, our chief collecting ground, was discovered by the Juan de Grijalva Expedition--4 ships, 200 men--on Ascension Thursday, 1518. This expedition was also the first to see Tulum--as we first saw it--from the sea (Fig.). Grijalva was on his way south along the east coast of Yucatan

following his discovery of Cozumel, May 3, 1518. On May 7 he sailed over ^{and south along} to the coast of Yucatan where he passed, as his chronicler recorded, "Three large towns separated from each other by about two miles. There were many houses of stone, very tall towers, and buildings covered with straw..."

"We followed the shore day and night, and the next day toward sunset we perceived a city or town so large that Seville would not have seemed more considerable, nor better; one saw there a very large tower; on the shore was a great throng of Indians, who bore two standards which they raised and lowered to signal us to approach them; the commander did not wish it. The same day we came to a beach near which was the highest tower we had seen and one discerned a very considerable town... We discovered a bay so large that a fleet might enter. It was lined with wooden buildings set up by fishermen."

Authorities are generally agreed that this "highest tower" was the Castillo at Tulum. "The large city or town," to my mind, was the "residential" part of Tulum. At Tancah undoubtedly was located one of the other three towns mentioned in the quoted account, and the great bay probably was our Bahía de Ascensión. Grijalva's expedition was the second of two outfitted in those early days at Santiago de Cuba for a search to the westward for slaves and/or gold. To the first of these, headed by Francisco Fernandez de Cordoba, is to be credited the discovery of Isla Mujeres in 1517.

Though the earliest beginnings of what was to become the great Maya civilization antedated the birth of Christ by several thousand years, the first Europeans to encounter the Mayas were the survivors of the wreck of an ill-fated Spanish ship on its way from Darien to Santo Domingo that foundered on a reef off Jamaica in 1511. Of the 19 who escaped, 7 perished in the course of the 14 days they were at sea in an open boat at the mercy of the prevailing easterly trade winds that carried them to coast of Yucatan.

The survivors Amarel

IN CONCLUSION

Although Mr. Bredin intended to give the expedition a full week of collecting in the Cayman islands, an unforeseen change in airplane schedules between Cozumel and Merida disrupted our plans. In consequence, we were vouchsafed but two days in Georgetown, Grand Cayman, before our charter expired on May 5. These days were largely occupied in getting our collections and collecting gear packed for shipment home. We were due to leave for Miami on the 6th of May, but, because of minor airplane trouble, we did not get away until the morning of the 7th. The 9th saw us back at work at the Museum and Dr. Daiber at the University of Delaware.

ACKNOWLEDGMENTS

Of the many to whom the Smithsonian Institution owes so much for the happy conclusion of a successful voyage to Quintana Roo--a still too little-known corner of the world--only a few can here be named: First of all, Mr. and Mrs. J. Bruce Bredin,

who suggested and made possible the expedition; Dr. Enrique Beltran, of the Secretaria de Agricultura y Ganaderi in Mexico City, who so wholeheartedly supported our objectives before the Mexican authorities; Pablo Bush Romero, who introduced us to Admiral Armando Canizares, chief of the naval district embracing Quintana Roo, who in turn gave us much more useful information about local weather conditions and navigational hazards; Mr. Neil L. Parks, our ever-helpful Consul in Merida; Dr. Raymund Zwemer, former Deputy Science Advisor to the Department of State in Washington; and last, but not least, throughout the voyage, my ever-industrious, cooperative, and congenial fellow members of the scientific staff of the expedition. We are also deeply to our Embassy staff in Mexico City, to the Federal Government of Mexico, to many of the residents of Isla Cozumel, particularly Father James Nagle, S.J., who interested the boys in his school in securing small stingrays in quantity needed by Dr. Daiber for his elasmobranch studies,

Boy who helped Daiber collect.

and to Mr. Robert S. Fuller, of Grand Cayman, a correspondent of the Museum, whose "Shell Shack Museum" we visited and who took us on one last collecting excursion before we left the island.

Photographs here reproduced were taken mostly by Dr. Daiber, and in smaller part by Dr. Clarke and myself.

The Smithsonian-Bredin Yucatan Expedition, 1960^①

By courtesy of the Mexican Government, the Smithsonian-Bredin Expedition for 1960 undertook to collect for study and report specimens of the marine fauna and flora (algae) occurring along the coast of Yucatan from Progreso east and south to Espiritu Santo Bay, Quintana Roo. The expedition's base of operations was a 76-foot schooner, the "Blue Goose" chartered out of Miami, Florida with a crew of 3, Captain, Thomas C. Burnett, mate, Hal Haines, seaman, Andrew Harvey.

Five zoologists comprised the scientific staff. Dr. Waldo L. Schmitt, research associate, Smithsonian Institution, marine biologist especially interested in Crustacea; Dr. J. F. Gates Clarke, curator of insects, U.S. National Museum, a ^{authority} ~~specialist~~ on the economically important Microlepidoptera; Dr. Haral Rehder, curator of mollusks, U.S. National Museum, who has in contemplation a paper on the molluscan fauna of the Quintana Roo littoral; Dr. Franklin C. Daiber, professor, department of biological sciences, University of Delaware, ichthyologist and ecologist whose chief interest was in making an ecologic study of a mangrove swamp and its associated fish population; and Dr. Edward L. Bousfield, curator of inver-

(2)

tebrate zoology, National Museum of Canada, Ottawa, a carcinologist, specializing on barnacles and amphipod crustaceans, chiefly the beach-inhabiting and other more or less terrestrial forms.

Although the "Blue Goose" sailed on March 20 from Miami with Drs. Rehder and Schmitt and the expedition's collecting outfit ~~aboard~~, the expedition did not actually get underway until Drs. Clarke, Daiber, and Bousfield came aboard in Progreso. From that port we departed for Isla Mujeres, March 26.

March 28-31 were spent at Isla Mujeres ~~making extensive collections~~ gathering shallow water animal life and algae. We were most fortunate here in making the acquaintance of Rear Admiral Armando Cañizares, in charge of the Seventh Naval District, Mexico, to whom we had a note of introduction given us by Pablo Bush Romero of Mexico City in Washington but a few weeks before our departure. Admiral Cañizares was most helpful and gave us much useful information about weather conditions, navigation, ~~and~~ anchorages, and the areas in which we hoped to collect.

April 1-3 found us ~~at~~ at San Miguel, ⁽³⁾
Isla Cozumel, taking on water and supplies
besides collecting on, and along shore, and
with electric light and dip-net over the
ship's side at night.

by diving,

April 4-7, we reconnoitered Espiritu Santo
and Ascension Bays but had to curtail
our activities because the captain had failed
to take aboard sufficient fuel for the "out-
boards" for the two weeks we had planned
~~to spend in~~ ^{for} this area. ~~After the two~~ ^{During the two} days ^{over} ⁽⁴⁾
spent going to Cozumel and back, April
10-19 were devoted primarily to Dr. Daiber's
ecologic study of ~~portions~~ ^{in Ascension Bay} of the great
mangrove swamp on the south side of
the long narrow peninsula on which ~~the light~~ ^{Allen Point}
house is located.

~~Ascension Bay~~ On
continently extensive invertebrate and
entomological collections were made on
land and along shore in the vicinity
of the lighthouse ~~at Point~~, in the
swampy areas, ~~on~~ on the far shore of
the Bay, ~~over~~ over the Nichaabin Reef east-
ward of our anchorage, and at the ~~the~~
~~the~~ northern end of the reef where it
joins the mainland. Our best "hauls"
of marine invertebrates, ~~and insects~~
and insects were made here and at Isla

The opportunity was taken to collect along the north shore of ~~Cozumel~~^{the} island, from shore out ~~to~~ to a depth of two fathoms, by diving. Collections were also made at Punta Molas near the lighthouse, and in the low brackish lagoon^s at the northern end of Cozumel.

^{much}
a needed preservative (formol) of which ⁽⁵⁾
^{we were in short supply}

April 25-27 ^(the rest of us) ~~the~~ went to see the Maya ruins at Chichen Itza, and on April 28, those at Uxmal. They are beyond description; words can scarcely do justice to the experience. Everyone who possibly can should visit those monumental and indeed magnificent ruins ^(of the once) ~~of the~~ ^{and flourishing} ~~great~~ ^{great} ~~though long past~~ Mayan civilization of which Tulum in its day was a significant part.

~~Drs. Bousfield and St.~~
Drs. Clarke and Bousfield departed for the States on April 25. The former to Washington, the latter to his post of duty in Ottawa.

April 30, ~~May 3~~
Leaving Cozumel on ~~the~~ ~~April 30~~ ~~we~~ ~~arrived in~~ ~~Georgetown~~ ^(came to) Anchored off Georgetown, Grand Cayman ~~in~~ in the late afternoon of May 3. That evening and the next day our chief concern was packing our collections and gear which were given over to the customs authorities for shipment in bond to ~~Washington~~ the Museum. On ~~the~~ May 6 we flew to Miami on our way home.

⑥

In the course of his six weeks expedition ~~was some~~ 119 collecting stations were established mostly in the marine littoral, ^{and} a limited number of plankton samples ⁽¹⁵⁾ ~~were taken~~ made with tow- and dip net. The latter with the aid of a submerged electric light over the ship's side. Dr. Clarke collected insects at 20 different places, along with other terrestrial arthropods, and, ~~also~~ on Cozumel, a number of bats. ~~Also~~

It is believed that number of marine invertebrates obtained may total 10,000. ~~Most of these are~~ Many of this are small, or even of microscopic size. Over 500 specimens of fish were caught, and in excess of 7500 insects pinned and dried.

The Institution, Mr. Bredin, the sponsor of the expedition, and the members of the field party are very grateful to the Republic of Mexico for the collecting permits granted them, and for the unflinching courtesy and helpfulness of the Mexican official and citizens with whom we came in contact.

Scientifically, the present expedition may be counted as one of the more

(7)

productive of the recent Bredin expe-
ditions in view of the limited number
of days that collecting was ~~under-~~
~~taken~~ after deducting time lost
travelling from place to place, and to
adverse weather conditions. Clear
fine weather was the rule, but ~~usually~~ ^{usually}
ly strong ^{and} persistent winds, not al-
ways favorable, blew ~~on~~ most of the
time.

The members of the field party
are quite unanimous in wanting to
return to this interesting and fascina-
ting part of the world for further
collecting.

When the various collections
have been worked up and reported
upon representative specimens will
be returned to the Mexican Govern-
ment, with copies of publications
based upon them.